BASIN OF THE MISSISSIPPI,

AND ITS NATURAL

BUSINESS SITE,

AT THE CONFLUENCE OF

The Ohio and Mississippi Rivers,

BRIEFLY CONSIDERED,

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NEW YORK:
NARINE & CO., PRINTERS, 21 WALL ST.

1851.

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Whoever is conversant with the elements that combine to make a vast city, must be strongly impressed with the natural advantages of the site of Cairo, at the junction of the Ohio and Mississippi, (Lat. about 36° N., Long. about 12° W. of Washington.)

To one familiar with the geography of the Old World, or the New, it is well known, that many of the largest cities are located in the interior, in many cases far inland, yet possessing easy natural water communications with the sea, and many business points.

Whoever has given his personal attention to the site of Cairo, whether upon the ground itself, or by studying the Map of the Basin of the Mississippi, has not failed to perceive, there is no point in this Basin so strongly marked by nature as this for a great city, nor one whose influence could be so readily wafted to remote points, and thence reflected back by the same navigable channels to Cairo, as a central mart of an immense business.

Enterprising minds have been active in studying all the bearings of this site, in reference to the Agricultural, Commercial, and Manufacturing interests of the North-West and the South-West States. It may be doubted, if any one who has given careful attention to this subject, has not come to the opinion, that the trade of a very large number of the valleys of these States, already begins loudly to call for a city at Cairo, to come forth with business facilities upon a scale commensurate in plan with the future increase of this trade.

What are these valleys? Some of the principal may be mentioned. Those drained into the Ohio, are the Tennessee (850*); the Cumberland (450); the Green River (308); the Kentucky (312); the Grand Kankawha (327); the Wabash (477); the Monongahela (216); the Muskinghum (216); the Alleghany (300). Those drained into the Mississippi, are, the Missouri (3217); the Kaskaskia (250); the Illinois (400); the Rock (285); the Lower Iowa (237); the Des Moines (400); the Wisconsin (580); the St. Peter's (400). The Ohio itself being 945 miles long, and the Mississippi 3500 miles long.

Almost all these rivers are navigated by steam-power, and the waters of all (and many more not here enumerated,) come together at Cairo, and are thence led off by the lower Mississippi to the Gulf of Mexico.

Taking the portions of the Western rivers that are navigated by steam, and applying these portions end to end, we should have a continuous navigable river of more than 12,000 miles in extent.

Now it happens there is no point above Cairo in ascending the lower Mississippi, to which steamers of the largest

* The figures following the names of the valleys, represent the number of miles in length of the rivers running through these valleys.

class can reach at all times, in all seasons—either from want of sufficient depth of water in midsummer, or from ice in winter. Cairo may therefore be said to be at the head of perpetual navigation in the great basin of the Mississippi ; and it naturally becomes a point where the navigation of the Western rivers requires a change of boats, which must make it a stopping place of an immense traffic.

In the middle of the North American Continent, a dividing ridge extends from the N. E. extremity of the Alleghany Mountains, nearly due west to the southern extremity of Lake Michigan ; thence N. W. to near the western extremity of Lake Superior ; thence W. N. W. to the Rocky Mountains. The elevation of this ridge is only about 1500 feet above the level of the sea. It is the water shed of the four great hydrographical basins east of the Rocky Mountains; the basin of McKenzie River flowing over 2000 miles into the Arctic Ocean : the basin of the Saskatchawan flowing even from the base of the Rocky Mountains, 1700 miles, into Lake Winnepeg and Hudson's Bay : the basin of the great lakes and the St. Lawrence, and the basin of the Mississippi, flowing over 3000 miles into the Gulf of Mexico.

The McKenzie and Saskatchawan, belong to the vast region of rocky and broken surface within the frozen soil. These two valleys therefore are of little value for the abodes of civilization. The St. Lawrence remains during its whole course, in the cold temperate zone. The upper portion of this basin—the valley of the lakes—is of immense value; and the only drawbacks, are a division of it between two different governments, and the coldness of its climate. The Mississippi alone flows south through the warm temperate regions, to seek a better climate under the more genial sky of the Gulf.

The Missouri-Mississippi, with its 3500 miles of navigation, is longer than the Amazon by 500 miles. The area drained by the Amazon, contains about 2,000,000 square miles—double the basin of the Obi, in Asia, which is the largest, though one of the least valuable, in the Old World.

The basin of the Mississippi is over 1,000,000 square miles—double that of the great rivers of China,* and three times the size of that of the Ganges or of the Indus. The rise of the Mississippi basin, from the shore of the Atlantic, as we go north, for an extent of thousands of miles, is so very regular, so gradual, so insensible, that the eye is scarcely able to perceive it, and we infer its existence only by the flow of the rivers. To ascertain it positively, we must resort to the instruments of the Engineer, which will indicate a fall of only a few inches to the mile.

The value of the basin of which Cairo will be made the centre of business, does not depend upon size alone. Other circumstances connected with its physical geography, should be taken into the estimate. Its adaptation as an instrument of development for the civilized societies who form themselves in it, should be carefully considered. In its adaptation, we perceive enough to allow us to affirm, that it corresponds admirably to the epoch of emancipation—of social equality, and of universal exchanges. From all parts of Europe, a superabundant population lands upon our shores ; we open our arms and welcome them. Every where our harbors are easy of access—the climate salubrious. The children of all nations come to unite themselves in the vast spaces of the West—presenting to the world for the first time a cosmopolitan nation. The West is the instrument which this new society finds at her disposal. She seizes it vigorously,

* "Yan-tse-Kiang" and "Hoang-ho."

and wields it with an ever-increasing success. An abundance of lands, rich in vegetation, minerals and raw materials, promises recompense to labor, and assures to it dignity and independence.

In the interior, the communications opened by nature herself, and being every day rendered still more accessible by art, respond to this need of locomotion, and facilitate this life of exchange, and of social intercourse, so characteristic of the age.

Our position in the middle of the ocean, between the two extremes of the Old World—Europe and Asia—must inevitably place in the hands of America, the best part of the commerce of the Old World. Who does not see the vast power of such a lever ? And who can deny that it is confided to the New World, to disseminate, broad as the world itself, the principles of civilization, self-government, and truth ?

Such being the obvious destiny to which nature herself seems to invite the communities who spread themselves over the broad plains of our continent, it becomes a question of physical geography, to ascertain the most feasible localities the country affords for the accomplishment of such high ends. In what precedes, some of the geographical features have been touched upon, with a view of bringing to a general comparison with each other, the four great hydrographic basins east of the Rocky Mountains. And this comparison demonstrates the superiority of the Mississippi to consist in size, climate, fertility of soil, natural channels of communication, centrality of position as regards the commerce of the Old World as well as the New, its sloping towards the south instead of the north or east, and its accessibility in reference to the Atlantic, at all seasons.

The area of that portion of the basin immediately north and east of Cairo, amounts to 400,000 square miles, (without including any below the junction of the Ohio with the Mississippi.) The natural products of this amount of soil, must seek markets by a descending trade along the rivers, whose waters all meet at Cairo. Then there is the up trade of what would naturally arise from the products of 600,000 square miles of the basin, south of Cairo, which ascends the lower Mississippi. Cairo stands as a natural business mart between the geographical divisions of the north half and south half of the Mississippi Basin. No one who has traversed, with an eye of intelligent observation, the numerous valleys composing this basin, doubts of its capacity to sustain as dense a population per acre as Belgium, which would give to the division above Cairo, a population of 128,000,000, and to the division below, 217,000,000, supposing both divisions equally populated. The centre of population of the United States, in the year 1783, was on the right bank of the Susquehanna, (town of Wrightsville, Pa.) It was a question of debate, whether this or Washington should be honored with the capitol. In 1840, the centre of population had moved westward very considerable, and slightly southward, to near Cincinnati, Ohio. The westward motion at the rate of $7\frac{9}{10}$ and the southern at the rate of $\frac{88}{100}$ of a mile per annum. At this rate continued, the centre of population will reach the meridian of Cairo in 1872, and the southern motion would bring it near the same place, at the same time. It is not probable the centre of population east of the Rocky Mountains, will ever pass much west of the Mississippi. It is not hazarding much to say, the centre of government of this growing people, will be not very far remote from the junction of the Ohio and Mississippi. The fertile and already immensely productive valleys composing the Mississippi basin, must have a point whence their products can be sent out at all seasons, maugre ice and low water. Who will deny Cairo the natural claim for such a business point, on a grand scale ?

But independent of all relation Cairo has by nature to the business of these valleys, it would become a large city from its connection with the business of the State of Illinois ;—a connection foreseen by its sagacious projectors, but not realized until lately. It is now made the southern terminus of the great Central Railroad of 650 miles in length, through the very middle of the State of Illinois to Peru, which is at the head of navigation on the Illinois River—which head of navigation is in connection with the head of Lake Michigan, by the existing canal. Likewise from below Peru to Chicago, there is to be another connection by a branch of the Central R. R. There is also to be a branch of the Central R. R., from Peru to Galena, Ill. Not only is Cairo made the southern terminus of this great Railroad scheme, but it is the northern terminus of the Railway running south through the State of Kentucky, across Tennessee, and down through the heart of Alabama to the sea, at Mobile City, which is the southern terminus.

The U. S. Government, under the influence of high views, and being convinced of the national benefits that would result by putting these extensive lines in operation, has stepped in and lent its powerful aid to these works, by donating on the most liberal scale, sufficient of the public domain to complete them all in a few years. Cairo comes in the middle of this iron chain, that is to unite Northern and Southern internal commerce, extending from the head of the St. Lawrence and Great Lake Basin, to Mobile.

In a political point of view, these projected railways will have more influence towards cementing the bonds of union between the North and the South, than any other project ever conceived of by Congress. Whether this motive entered into the views of Congress in lending its patronage, I know not. But the works once in operation, it requires no great prescience to perceive that demagogues and agitators may as well abandon all idea of making the people of the North and of the South believe in the possibility of political disunion.

Cairo would neither be a Northern nor a Southern city ; it would be the central mart, where exchanges from the North, South, East and West, would take place ; and by this commingling of commercial interests, a good influence would radiate thence in the four directions, to the remotest parts of the Republic.

IMPROVEMENTS AT CAIRO CITY.

In devising a plan for the improvements at Cairo City, there should be taken into the design the following important questions of engineering : Prevention of inundation ; protection of river banks from abrasion ; business levees ; harbors ; drainage ; levee streets ; railway ; material ; stability ; gradation of streets, and economy in expenditures.

To execute a work in reference to one of these questions, isolated from all connection with the others, might entail serious consequences, not only in wasting money, but in hazarding that ultimate perfection of a whole, that might be attained ed by harmonizing all these points in a general design beforehand.

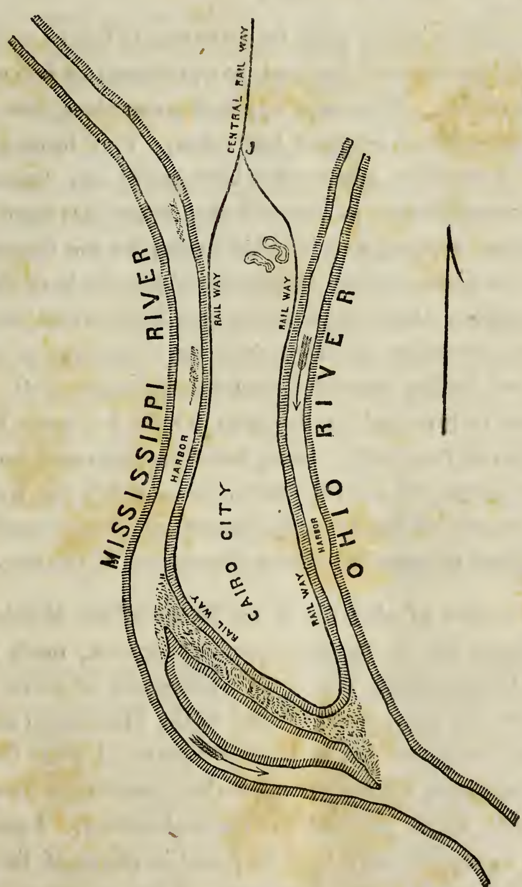
In any plan therefore for any particular improvement, the condition of adaptation to each of the foregoing points, should be involved ; and whenever a plan is submitted for one that militates against the others, it should be rejected.

In my opinion, the place should have provision for a street to be extended all along on the top of the dyke, not only down on the Mississippi side, but following around in a curve, and along up on the Ohio side. This I will for brevity, call "Levee Street." The top of this street should be from 8 to 9 feet above the level of the natural banks—which will carry it to 3 feet above extreme high water. This extreme high water is the stage I witnessed at the site, in the highest inundation ever known—June, 1844.

This street would be the top of the dyke that is to prevent inundation. The slope of this towards the water, should have an inclination of not more than 1 foot vertical to 5 feet horizontal. This slope should be made in a uniform grade, down to extreme low water's edge. This slope should be the business levee, and should extend all round the water side of both rivers, and be paved with stone—similar to all the well known levees of the Western river cities.

In finishing these pavements, care should be taken to adapt the work to answer all required conditions for the embouchures of the main drains or sewers of the city. Likewise in constructing the dykes, the culverts for the drains ought to be previously located, so that they can be made at the same time of constructing the dykes. This, it will be seen, implies the location of the main sewers, before the construction of the dykes, or else—what would be false economy—the dykes would have to be afterwards cut through, to pass the drains. The location of the main drains, necessitates the gradation of the streets by the spirit level, so all can be represented in exact profile on paper. It will not be necessary to actually grade the streets before the levels of the embouchures of the drains can be prepared in the constructions for the dyke.

On top of the dyke following the Levee street, the Railroad should be extended all round. That is, in coming down from the north, the Railroad should diverge to the westward a little, at some proper point (J) and strike the bank of the Mississippi near the foot of the lower sand bar, seen in Long's map, and follow down that bank, leaving sufficient berth between it and the low-water line, to exactly admit of the insertion of the proper works, to protect that bank from abrasion, to form the business levee and the levee street.



And so on, extending the Railroad down and around the toe of the peninsula, and along up the Ohio bank, to the upper angle of the city, and then deflecting from the Ohio and passing out of the city, so as to return into itself at J. The depot could be placed at the most convenient place on the loop of the Railroad that would be thus formed. The Railroad would thus encircle the peninsula, and would not pass through the heart of the town.

On the Mississippi side, for an extent of from 4 to 5 thousand feet, abrasion of the bank has produced an indented or concave shore. The mean depth of water along here, is 19 feet at the stage of extreme low water. It is fortunate that while this abrading process has been going on, threatening serious consequences to the town site, nature has been in the mean time, shaping an admirable harbor for the future business of the place, on the Mississippi side—for here the harbor should be. In protecting this bank from farther abrasion, the works therefore should answer the conditions of a good harbor and landing place for steamers and other craft. This condition is involved in the plan which I present for the protection of this bank ; it also embraces the conditions of a business levee, of a levee street, upon which the Railroad should be, and of the dyke, to prevent inundation—and militates against no contemplated improvement of the site.

The causes of abrasion of the banks of the Mississippi, are stated in full, in my official printed reports, made to the U. S. Government, during an experience of three years service on the surveys of the *Bed* of the Mississippi and the Missouri, in connection with other duties. I differ from all other Engineers, except some who may perchance have read my reports, as to the cause of these abrasions. I maintain that the root of the evil is to be found in stages of the river below medium and usual low water. They, on the contrary, hold that the evil is to be found in stages above medium and up to high water.

In my researches in the bed of the river, in various places, I have come to this practical result, which I here state, because it serves as the very basis upon which any work, to stand in the river, must be planned and executed.

After reaching the bottom of the water, we come to a layer or stratum, varying in thickness or depth, from 12 to 22 feet, (which stratum I have marked M, in the sectional drawing,) and which is of extreme mobility. It is in this easily moved mass, that the under currents in medium stages and in low water, are working mischief, so to speak. A pile driven into this stratum only, or a dam built upon it, or a crib resting on it, or any work of engineering of the ordinary kind, applicable to hard bottoms, is certain not to stand. Piles of stone, with this as a foundation, do not stand; they sink and spread out, and are lost. The currents in low water stages, cut entirely down through this stratum, to a certain depth, and the depth to which their influence penetrates, is the limit of the depth of this moveable stratum, M. This depth is determinable. Below this there ensues the stratum of under ground, which is more permanent in position, and not acted on by the under currents, being below their influence. This stratum I have marked P.

All works in the Mississippi must, to stand, be planned and executed in reference to the stratum P as a foundation, and not with reference to M as a foundation. The stratum P is compressible, but is not undermined by the river currents, nor moved by their force. Piles will stand if driven well into P. Stone will only stand when the mass is rested on this bottom, and will stop sinking as soon as the force of restitution, or reacting spring of this stratum, is equal to the weight in water of the stones compressing it—then will the stone pile stand. In all solid cribs or stone piles, we must fill up as fast as they will sink, until they attain to this position of stability ; and hence the vast amount of work required to execute a plan of stone revetment, or stone dam or crib work. Those Engineers who have been familiar with hard bottoms, in the execution of their works, do not appreciate this difficulty.

This moveable stratum (M) being borne in mind, it becomes a very simple problem to solve the abrasion of a bank. The direction of the stream at low water, setting obliquely against the bank, carries the main channel near that bank, by the under current washing or cutting out, and moving along the matter in the stratum M, and thus undermining the bank ; and this will reach so far in, that frequently in low water, when the banks are not saturated, they stand vertically, and even overhanging, until the cohesion of the mass is overcome by its own weight, then a slide of earth takes place into the river, and is washed down and swept around, and forms some new deposit, or goes to augment one already commenced. But in most cases, the bank holds, although it has been undermined, until the periodical rise of the river comes ; then the banks being full, become saturated—great masses slide off and are carried along. To Engineers who have taken a superficial view, it appears that this high water stage performs all the mischief, whereas these high water stages only manifest the evil done in low water stages, or medium, and from that down to extreme low water.

I have only dwelt on the cause of abrasion, because this is the only serious difficulty to be grappled with on the Mississippi, and which, if not arrested, will undoubtedly wear a very deep indentation into the west side of the Cairo site, unless some fortunate change, which is by no means impossible, occurs in the reach of the river above Cairo, and below the ground chain. Such a change in that reach, may occur within a short period, as to render very expensive works for the abraded bank at Cairo, unnecessary. A proper reconnaisance made in low water, by one competent to the task, will settle this question,—for all the changes that occur at a given point, or rather in a given reach, are produced by the *direction* of the stream in the next reach above, until you come to the rock barriers. Should the abrasion at Cairo, threaten to continue there to the extent of cutting through, or wearing off considerable of the site, then it should be arrested.

I now proceed to explain the plan I have designed for this case of the abrasion on the Mississippi side of Cairo.

I find by Capt. Long's soundings, the mean depth of water along the abraded bank, was 25 feet ; and that this mean depth is about equal to the mean depth any where in that part of the river. This shows a decided deep channel close in shore, along in that bend. The velocity of the water there is not given, which is a defect in the survey ; extreme low water is six feet below the stage of his soundings, which would make the mean depth of water at the lowest stage, 19 feet. The depth of the moveable stratum (M) will be found not to exceed 15 feet. Had I the velocity, I could be more certain of this element of the plan ; but I think I am safe in calling M 15 feet deep. Then we come to a stratum (P) which is sufficiently permanent to rely on for foundations, in all stages of the river. From extreme low water down to stratum P, is 34 feet.

Suppose a line (*L*) convexed towards the shore, extending longitudinally along the river, parallel with the general line of the bank, (along where I have marked "Harbor" in the Mississippi,) and at a distance of 50 feet from and west of the low water line. There will be thus left a border of the river between this supposed line *L*, and the city shore, of 50 feet in width. All along on the line *L*, drive a row of substantial square piles, not less than 12 inches in diameter, in juxtaposition, 16 feet into the stratum P. This row of piles to extend from a little above where abrasion commences, down to where it terminates. This line of piles will constitute the river face of the artificial bank, and will be the face of the harbor. The tops of the piles to be left below extreme low water. Back of this row, at twenty feet towards the shore, drive a pile occasionally, so that another line shall be formed parallel with the line *L*. The piles in the second line, to be 20 feet apart. These serve to attach ties to, and as stays to facilitate the operations of the work as it progresses. A stringer is to be attached to the heads of the piles in *L*, and at every 20 feet a tie (t) is to extend back to the corresponding pile in the inshore row, and attached to it. None of the wood work is to be left, when finished above extreme low water, to ensure no decay. At first view, there appears a difficulty in executing the works below low water. This, however, can be done by a skilful constructing Engineer, who would not be biased by some favorite plan of his own for the whole work.

Between the row of piles *L*, and the shore, there is now a space of 50 feet in width to be filled, marked F ; this should be filled with earth, brush and stones. The proportions of these should be so adjusted, as to make the specifie gravity of the mass, a little more than that of water—using more brush up next the front row of piles than farther back ; we may thus entirely avoid unequal pressure on the sides of the piles, and they will stand without being pushed over towards the river. Having filled the space F, up to extreme low water, then fill up to grade of the slope of the bank—which slope is to be 1 to 5—all the way up to the top of the natural ground. Then form the embankment E, which is to serve as the dyke, on top of which the Levee street and the Railroad are to be. The inner slope of the dyke to be also 1 in 5. The whole to be paved with stone, from extreme low water up to the street—the street itself and the inner slope likewise.

The cross section of the work is seen in drawing, No. 1.

Drawing, No. 2, explains how the work should be executed, if stone be used instead of timber. S, represents the section of the stone pile, after enough has been put in to fill from stratum P, up to extreme low water. The filling, in this case (unlike the other at F,) to be done entirely with earth graded from the bank ; and also the embankment E to be made from the same source.

The face of the work should be set off 50 feet from the low water line, because this space would be needed to work the boats, pile driver and scows in ; and besides, this and the embankment E, will just about swallow up all that is to be graded off the bank to form the slope of the levee.

The estimate will now be presented for each kind :

One Mile of River Bank—*Drawing, No.* 1.

1 Steam Pile Driver, - - - -	$1,500 00
2 Working Scows, with fixtures for business,	600 00
1 Steam Saw Mill, - - - -	2,000 00
Machinery, -	$4,100 00
5280 Piles for row *L*, 262 for back row, at $3,	16,626 00
5280 feet Stringers, - - - - -	105 60
262 20 ft. Ties, at 40c., - - - -	104 80
Labor of men and subsistence, driving piles, &c.,	3,324 00
Labor of putting on Stringers and Ties, - -	841 60
Carried over, -	$25,102 00

Brought over, -	$25,102 00
Grading off the natural bank—411,038 cub. yds.	
Of this, 220,017 cub. yards to be put into E, to complete it, at 10c., - -	22,001 70
" 189,076 c. y. to be put into F, at 5c.,	9,453 80
Brush filling, and stone to sink it, in E, 94,449 cub. yds., at 15c., - - -	14,167 35
Paving with stone, Business Levee, Levee st. and inner slope, 72,600 c. yds., at $1.50,	108,900 00
Engineering, superintendence and contingencies, 10 per cent., - - -	17,962 48
Total, -	$197,587 33

Which brings it to about $37.46 per running foot. What now does this accomplish? It protects the bank from abrasion; it makes a first rate Harbor; it makes a broad business levee; it forms a permanent Levee Street, 80 feet wide; it forms a perfect Dyke to prevent inundation; it forms the Railroad Embankment—all under one general system.—When the water is at extreme high stage, there will then be left a perfect business levee street, with 20 feet of its exterior slope, and 45 feet of inner slope—making 145 feet in width for business—while most of the Western cities are left without any levee in these high stages. It was particulaly so, at St. Louis and Louisville, in 1844.

Should 80 feet be regarded too wide for the top of the dyke, then the following rule observed, will give the estimate: Diminish the amount of the foregoing estimate by 10 cents for each foot less than 80, the top of the dyke may be made in width. For example, if the levee street be 60 feet wide, which is 20 feet less than 80, the deduction will be $2 for every running foot of bank, which would make the whole works cost $35.46 per running foot. If the top of the dyke is only sufficient for a railway of double track, it should be

26 feet, which is less by 54 than 80—this will reduce the cost to nearly $32 per running foot for all the works.

I have before remarked, the velocity of the Mississippi, where the abrasion is, is not given in the survey. It is possible this may be so great, the piles could not be driven with that precision the plan contemplates. Should this be so, a modification of the foregoing plan, No. 1, will be required—but this would not enhance the cost. It would perhaps lessen it; but the work would not present that uniformity of face, for harbor purposes. The piles would have to be driven as near in line, and at stated distances, as possible, and a different method of ties be introduced, as well as of filling, to form the face of the work, but the main features would be the same.

The estimate will now be given for one mile of construction, using all stone, and no timber.

ONE MILE CONSTRUCTION—*Drawing, No.* 2.

The base of the stone would ultimately have a width of 74 feet, and the top about 6 feet, and the height, after sinking, would be 34 feet. The method of depositing these stones, would be, to commence with a base of 40 feet in width, and drop the stone on this—continually drawing in as we fill up, after the stones have settled, and spread to rest on the stratum P, as they would by the washing out of stratum M.

265,954 c. yds. of stone, quarried, transported, and deposited by contract, at $1.50,	$398,931 00
Grading off the bank—411,038 cubic yards—	
Of this, 220,017 c. y. put in to complete E, 10c.	22,001 70
And 191,021 " " to fill F, at 5c.	9,551 05
Paving levee, Levee street, and inner slope, 73,920 cubic yards, at $1.50, -	110,880 00
Contingencies, Engineering, 3 per cent.,	16,240 91
Total, -	$557,604 66

This would bring all the works up to $105.67 per running foot of bank. It is possible the stone might, on so heavy a contract, be got and deposited somewhat cheaper, which would reduce the cost.

It is to be observed No. 1 and No. 2, apply to the abraded bank on the Mississippi. The plan represented in drawing, No. 3, is what I should adopt, where harbors are required, as on the Ohio side, where no abrasion is to be feared.

This construction would be as follows: Let there be set off about 20 feet from the extreme low water edge, and drive a row of piles, leaving a border of river about 20 feet wide, all along the site for the harbor. The piles should be six feet apart in the row, and 30 feet long, running 18 feet into the bed of the river. Should the 20 feet above specified, not give 12 feet depth at stage of extreme low water, then set off the row of piles, until 12 feet depth is attained. Drive the piles until the heads are below extreme low water; put down on the inside of this row, a sheeting of 3 inch plank; then fill in at F with earth, (cut from bank C) brush, and a few stones—proportioned so as to have the specific gravity of the compound mass some greater than water—the more brush the better, consistent with that condition. Slope the bank C, and use the material to form the embankment E. Pave the slope of the business levee, the Levee street, and the inner slope.

One Mile of Construction—*Drawing, No.* 3.

Machinery, - - - - - - -	$4,100 00
880 square piles, 30 feet long, at $1.80, -	1,584 00
190 M. board measure, 3 inch plank, put in place, at $15 per M., - - - - -	2,850 00
Embankment at E, 220,017 cub. yds., at 10c.,	22,001 70
Filling at F, 23,443 " at 15c.,	3,516 45

Wasting of earth out of C, (contingent) -	2,000 00
Paving 71,966 cubic yards, at $1.50,	107,949 00
Engineering, contingencies, &c., 10 per cent.,	14,400 00
Total, -	$158,401 15

Which brings the cost to $30 per running foot of river front.

The same rule of reduction will apply as in the other cases, for diminishing the width of Levee street.

The Railroad track, after leaving the Ohio at the N. E. angle of the city, to return into itself at J, should be laid on an embankment represented in cross section by drawing, No. 4, being 3 feet above extreme high water, 60 feet wide on top, and with slopes of 3 to 1—the top of the embankment serving as a street, as well as for the Railway, and the embankment for a dyke. In coming down from J to the head of the Mississippi Harbor, a similar embankment should be constructed for the same ends. It will be unnecessary to pave the inner slopes of these embankments; they may be put in grass or shrubbery, (excepting where they are intersected by the city streets): but the outer slopes should be paved, to resist the washing by the currents, in time of inundation, from either river.

One Mile of this Work.

153,120 cubic yards in bank, at 15c., -	$22,968 00
Paving top of Embank't, 11,721 c. y., at $1.50,	17,581 00
Paving outer slope, 5,860 " "	8,790 00
Engineering, superintendence, &c., 2 per cent.,	988 78
Total, -	$50,327 78

This work comes to $9.55 per running foot of embankment. If the embankment be reduced to 20 feet in width, on top, it would cost $5.23 per running foot of embankment.

Should the narrow policy be allowed to prevail, by extending a single embankment down from J, and terminating the Railroad at some point, then it would be necessary to enclose sufficient ground for a depot, by a dyke of sufficient width on top for a double track—in short, a circle would have to be dyked around, and the dyke 26 feet wide on top, and sloped as in drawing, No. 4—paved on top and on the outer slope. This would cost $5,87 per running foot of embankment. And after leaving the dyked area in going out towards J, until out of reach of inundations from either river, the embankment for a single track would not be less than 20 feet wide on top, and should be paved on both slopes, but it would not be necessary to pave the top. Its cost would be $5.80 per running foot of embankment. And there would have to be a business levee and harbor on the Ohio side. Supposing the Railroad thus constructed, and the town to be improved afterwards, it is easy to perceive, there would be an enormous waste of money, and the city site would be greatly impaired, and the Railroad terminus would not be so convenient for itself, nor so advantageous for the business of the rivers. All arising from a want of harmony in the outset, in a general plan for the works, which the importance of the site justly demands from those who have the responsibility of these contemplated improvements.

T. J. CRAM,
Capt. U. S. T. Engineers.

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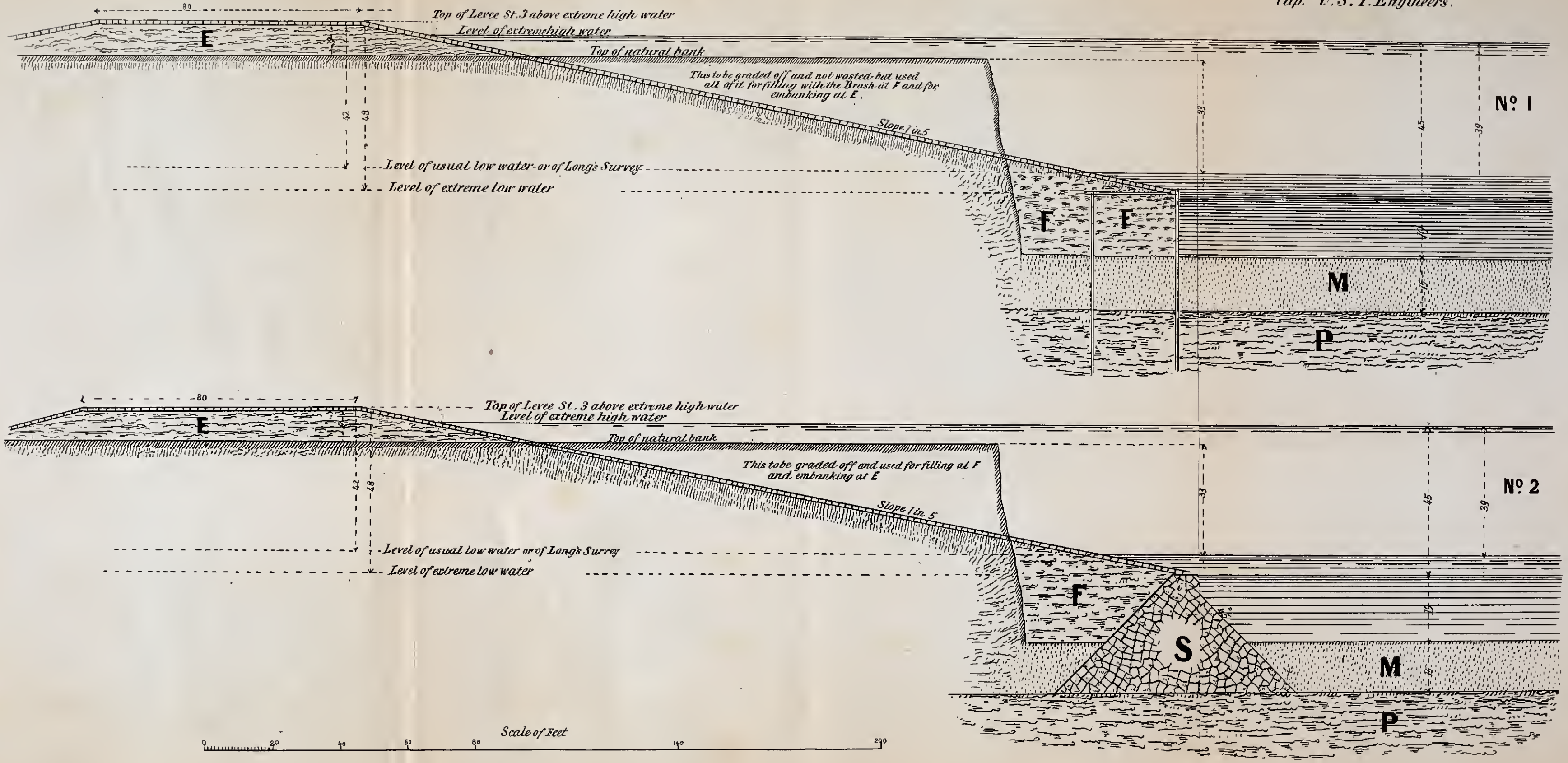
T. J. CRAM,
Capt. U. S. T. Engineers.

Designed for Protecting the bank of the Mississippi from Abrasion at Cairo City and for forming a business Levee, a Levee Street, a Dyke to prevent inundation, and a Harbor on the Missisippi side of the town – all at the same time – The Railway to extend along the Levee Street – the Street itself serving as a Dyke.

by T. J. Cram.
Capt. U. S. T. Engineers.



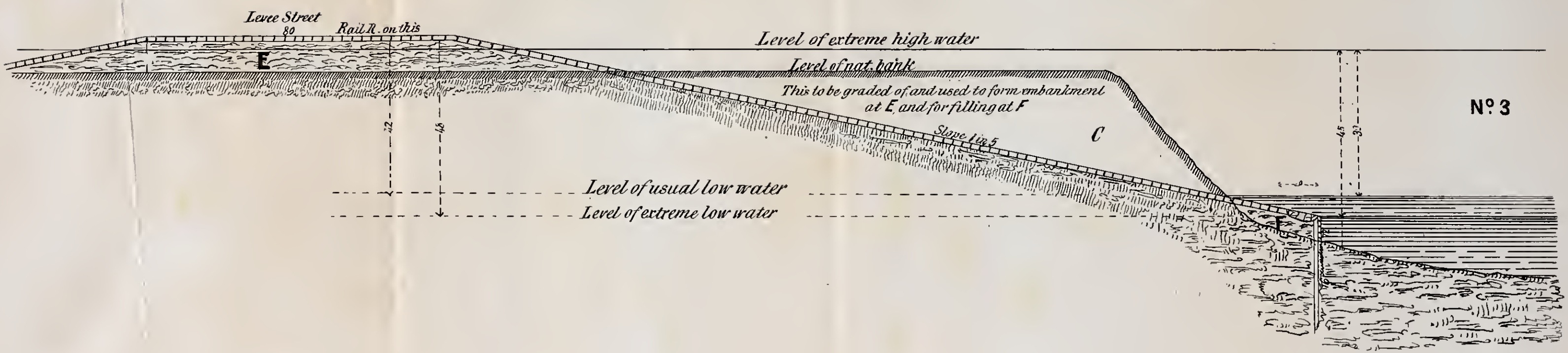
Designed *for the* **Harbor** *on the* **Ohio** *side of* **Cairo**

for a **business levee** *and a* **levee Street-Dyke** *to prevent inundation*

The Rail Road *to occupy a part of the St. The Street itself forming the Dyke.*

—Where there is no abrasion of river bank—

by T. J. Cram.



Nº 3

Nº 4

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